CASTING & CASTING ERRORS

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Casting

- It is the process of melting the metal alloy and forcing it quickly in a mold cavity.
- Melting of the alloy can be done by several process:
- 1- Blow torch

    a) simple gas air torch (pr & semi-pr)

    b) gas oxygen torch (multi-orifice, base metal alloy)

- Blowpipe flame consists of many zones

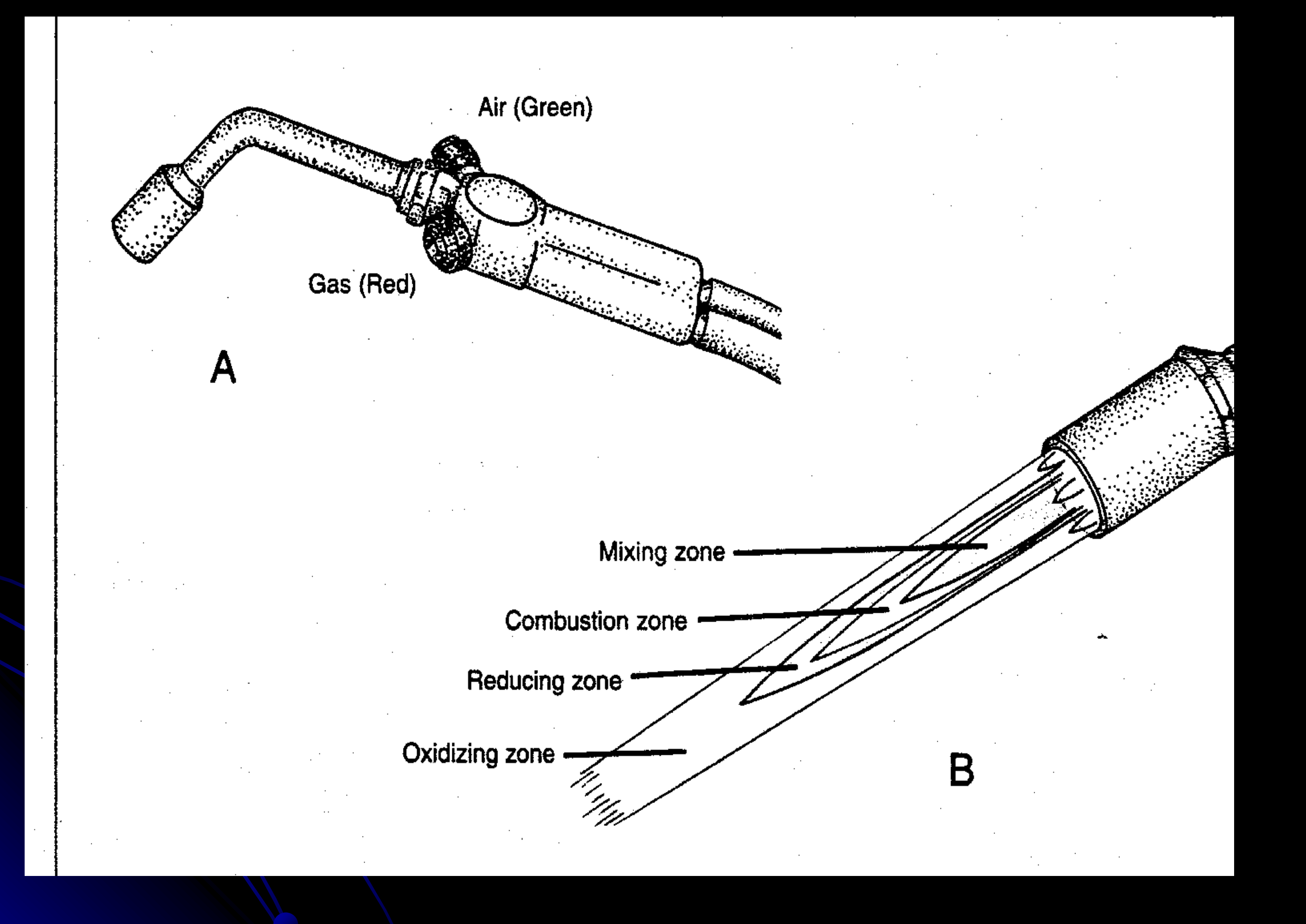
1- mixed zone: colourless and pure gas

2-consumption zone: mixture of gas and air

3-reducing zone: the hottest zone (light blue)

4-oxidizing zone: the outer zone (red)

The reducing zone is used to melt the alloy as it is the hottest and prevents the formation of oxides.


Air (Green)
Gas (Red)
A
Mixing zone
Combustion zone
Reducing zone
Oxidizing zone
B

- 2- Electricity
  a) conventional heating muffle
  b) induction current

Flux:

It is a reducing agent that is added to prevent oxide formation; increase fluidity of alloy; and reduce the melting temp of the alloy.

Mainly used with precious alloys; borax is most commonly used.

Casting machines

- Air pressure technique

The molten alloy is forced into the mold by air pressure which consists of compressed air or gases as $CO_{2.}$

The alloy is placed in the crucible and melted by a torch, then pressure is applied

Gives low casting pressure and used with precious and semi-precious alloys.

- Vapor pressure technique

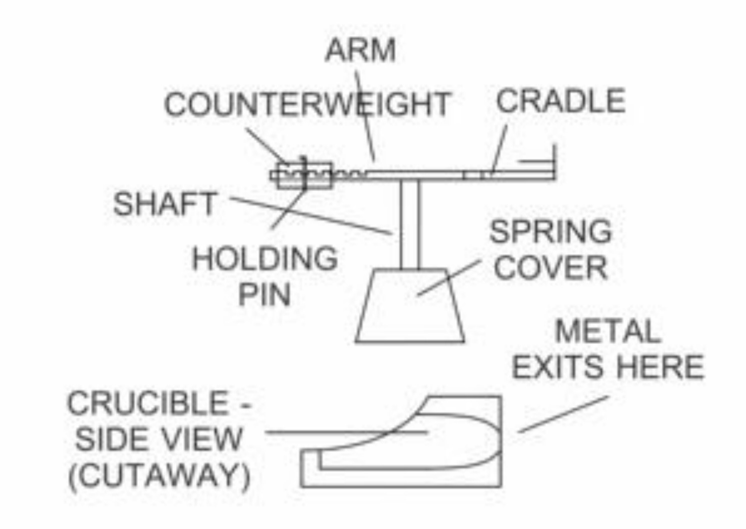
The machine has a cover lid that is lined with wet asbestos. When the alloy is ready the cover is placed producing vapor which pushes the molten alloy into the mold.

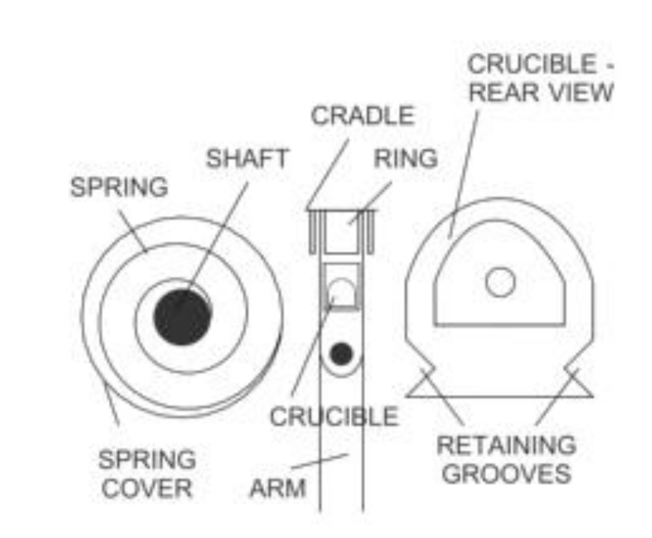
Used with pr and semi-pr alloys, also gives low casting pressure.

- Centrifugal casting technique

It gives high casting pressure and can be used with all types of alloys.

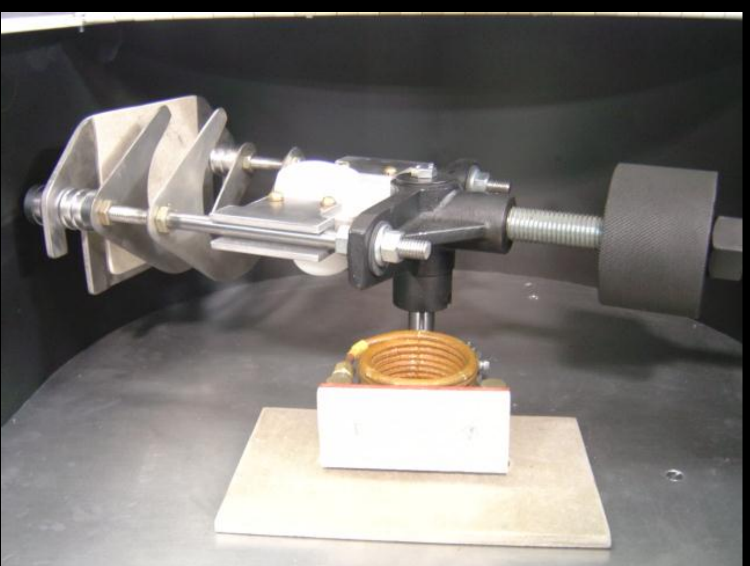
It consists of a base joint with a mobile arm and a strong spring. One end of the arm the crucible with the molten alloy and the other a equal sized counter balance. The spring is turned several times clockwise and fixed with a pin. When all is ready the pin is released and the centrifugal force pushes the alloy into the mold.


ARM
COUNTERWEIGHT
CRADLE
SHAFT
HOLDING PIN
SPRING COVER
METAL EXITS HERE
CRUCIBLE - SIDE VIEW (CUTAWAY)


CRUCIBLE - REAR VIEW
CRADLE
SHAFT
RING
SPRING
CRUCIBLE
SPRING COVER
ARM
RETAINING GROOVES


POWER
POWER SWITCH
ECCO
ECCO MINICAST


ECCO MINICAST



- Vacuum casting technique

The air in the machine is evacuated which helps casting and reduces casting errors.

Important notes:

Properly molten alloy has rounded edges and mirror in appearance

Graphite crucible for gold alloys

Ceramic crucible for base metal (contamination)

Recovery of the casting

- For precious alloys:
- The ring is quenched when the red glow of the button disappears. This helps disintegrate the investment.
- Picking in warm HCl solution to remove black oxide layer
- For base metal:
- Ring cooled to room temp, the broken manually.
- Sandblasting with Al_2O_3 particles under pressure

Sandblaster



Finishing and Polishing

- Using uncontaminating stones and disc the sprue and button are removed.
- Polishing is done using rubber wheels, with the help of iron rouge.
- Proper F & P:

decreases plaque accumulation

decreases tarnish and corrosion

Casting Errors

- **No Casting:**

Sprue blockage: investment fragments/ metal sprue not removed

Molten metal not directed to mold

Premature metal solidification: cold ring/ incomplete heating of alloy/too wide sprue which allows alloy to enter and solidify

- Low casting pressure
- Fracture of the investment at the base (too thin layer)

- **Frayed Margins (fins)**

These represent cracks in the investment that has been filled by the molten alloy.

Dropped investment

Increases W/P ratio

Too rapid/ over heating of investment

Pattern placed too close to base (easily cracked)

Fins can be removed, remake if at margin

- **Bubbles or nodules**

These consist of trapped air between the wax pattern and investment. Will prevent seating of restoration.

Trapped air during investing

Inadequate vacuum during investment mixing

Lack of debubblizer (surfactant)

Can be removed if not at critical areas

- **Rough surface: (surface porosity)**

Casting should be smooth, roughness can occur from:

Rough wax pattern

Excessive wetting agent or investing before agent is dry

Investment material has large grain size

- **Incomplete casting:**

Inadequate amount of alloy

Inadequate heating of alloy

Inadequate casting pressure

Incomplete wax burnout

Too long sprue

Cold ring

- Incomplete casting can occur at several sites.
- Margins:

Rough: foreign body

Convex: insuffiecent casting pressure/cold ring

Concave: trapped air from less venting/ incomplete wax burnout

- Perforated casting:

At sprue: insufficient alloy

At thin areas (veneering areas) isufficient accessory sprues

- **Porosity:**

There are amny types, macro, micro, internal and external.

1- back pressure porosity:

low casting pressure(not enough to push air)

not enough venting

not enough porosity of investment

short sprue

2- Gas inclusion porosity

Blow torch (not using reducing zone)

Over heating of alloy (boiling)

Vapors from overheating of investment

3- shrink-spot porosity:

shrinkage of a portion of the metal as it solidifies from the molten state without flow of additional metal from the surrounding areas.

4- Suck back pressure porosity:

occurs when the metal in the sprue cools before the metal in the mold.

5- Subsurface porosity:

Dangerous as it only appears during the finishing stage. Due to cold mold where the superficial metal cools and compensates from the inside part.

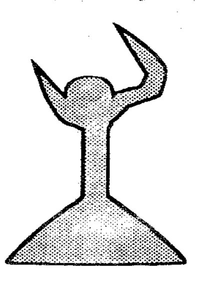
- **Oversized undersized casting:**

to prevent this attention must be placed during the whole casting process, from choosing the correct investment material; p/w ratio; heating of investment etc.

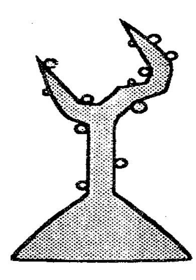
Undersized casts can be stripped from the fitting surface

- Discoloured casting:

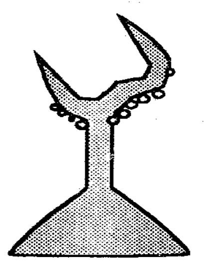
Occurs when there is decomposition of the gypsum bonded investment, releasing S which combines with Cu and Ag of gold alloy. This compound resists pickling and remake is the only solution.



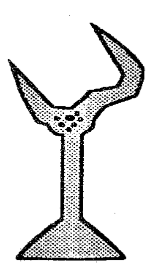
Large nodule—
Air trapped during investing.



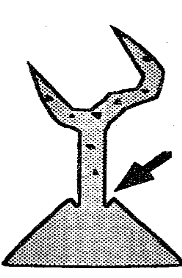
Multiple random nodules—
Inadequate vacuum during mixing.



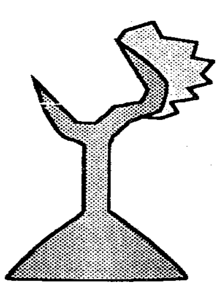
Nodules on underside only—
Prolonged vibration after pouring.



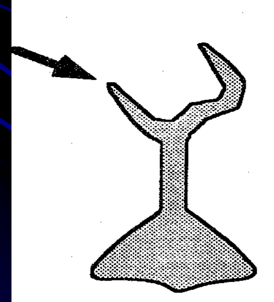
Shrink-spot porosity—
Spue attachment too bulky.
Sprue too long or thin.
Button too small.



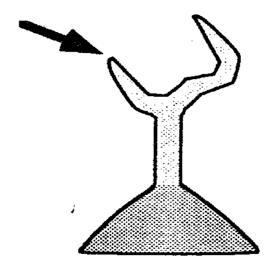
Random porosity—
Dirt in wax pattern.
Loose particles of investment
from sharp edges *(arrow).*



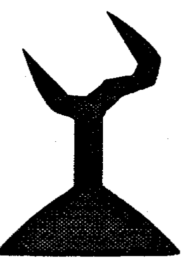
Fins—
Dropped ring, rapid heating
of wet or unhardened mold,
liner flush with end of ring.
excessive casting force.



Short, rounded margins with
rounded or lumpy button—
Alloy not hot enough or
insufficient casting force.



Short, rounded margins
with sharp button—
Pattern too far from end of ring
or, if casting is shiny, incomplete
burnout of wax.



Black, rough casting—
Breakdown of investment
from excessive heat.